

1 **ABSTRACT**

2 An optical apparatus comprises an optical waveguide, a bottom surface and
3 walls formed on a first substrate and defining a detection volume with an upper opening,
4 and a photodetector active area formed on a photodetector substrate. The bottom
5 surface may be provided with a reflective coating. The waveguide is positioned relative
6 to the detection volume so that light emerging from an end face of the waveguide is
7 received within the detection volume. The detector substrate is mounted on the first
8 substrate so as to cover the upper opening of the detection volume with the active area
9 exposed to the detection volume. The optical waveguide may be formed on the first
10 substrate along with the detection volume, or the optical waveguide may be formed on a
11 separate waveguide substrate, and the waveguide substrate assembled with the first
12 substrate.